

WHAT IS CLAIMED IS:

1           1. An ultrasonic monitor for measuring pulse rate values in a living  
2 subject, comprising:  
3               a) at least one source of ultrasonic energy;  
4               b) a gel pad comprised of a polymer and from about 50 to about 95 % by  
5 weight of an ultrasound conductive diluent, wherein said polymer is characterized by having  
6                   i) needle penetration from about 5 to about 300 (1/10 mm) according to  
7 ASTM D15;,  
8                   ii) tensile strength from about 5 to about 500 psi according to ASTM  
9 D412; and  
10                  iii) elongation from about 50% to about 800% according to ASTM  
11 D412;  
12                  wherein said gel pad is positioned directly between the energy source and the  
13 living subject;  
14               c) an ultrasonic energy detector; and  
15               d) associated hardware and software for detecting, calculating and displaying a  
16 readout of the measured rate values.

1           2. The ultrasonic monitor of claim 1 wherein said polymer is  
2 characterized by having  
3               i) needle penetration from about 25 to about 150;  
4               ii) tensile strength from about 10 to about 300 psi; and  
5               iii) elongation from about 200% to about 700%.

1           3. The ultrasonic monitor of claim 1 wherein said polymer is  
2 characterized by having:  
3               i) needle penetration from about 30 to about 50;  
4               ii) tensile strength from about 50 to about 200 psi; and  
5               iii) elongation from about 300% to about 500%.

1           4. The ultrasonic monitor of claim 1 wherein said monitor is in the form  
2 of a wristwatch with attached wristband.

1           5. The ultrasonic monitor of claim 1 wherein said polymer is selected  
2 from the group consisting of acrylonitrile-butadiene-styrene, polyurethane, and silicone.

1               6.     The ultrasonic monitor of claim 1 wherein said ultrasound conducting  
2 diluent is selected from the group consisting of dibutyl phthalate, dioctyl phthalate, mineral  
3 oils, naphthenic oils, paraffinic oils, polybutenes, silicone fluids and vegetable oils.

1               7.     The ultrasonic monitor of claim 1 wherein the energy source and  
2 detector are located within a module and communicate by wireless transmission with the  
3 processing and display hardware.

1               8.     The ultrasonic monitor of claim 7 in the form of a wristwatch.

1               9.     The ultrasonic monitor of claim 7 wherein the processing and display  
2 hardware are housed in a separate module.

1               10.    The ultrasonic monitor of claim 9 wherein the separate module has the  
2 form of a wristwatch.

1               11.    The ultrasonic monitor of claim 1 wherein the energy source and  
2 detector are located within a module and are hardwired to the processing and display  
3 hardware.

1               12.    The ultrasonic monitor of claim 11 in the form of a wristwatch.

1               13.    An ultrasonic monitor of claim 1 in which the module is integrated into  
2 or held in place by a headband.

1               14.    The ultrasonic monitor of claim 1 wherein said source of ultrasonic  
2 energy comprises a first and a second piezoelectric crystal, wherein the crystals are  
3 positioned at an angle to each other, said angle determined based on the distance of said  
4 energy source to the pulse living subject.

1               15.    The ultrasonic monitor of claim 14 wherein said first piezoelectric  
2 crystal is energized by an original ultrasound frequency signal, wherein the original  
3 ultrasound frequency signal is reflected off the living subject and received by the second  
4 piezoelectric crystal, and wherein said received ultrasound frequency signal is higher or  
5 lower than said original ultrasound frequency signal depending on direction and speed of  
6 fluid flow.

1                   16.     The ultrasonic monitor of claim 15 wherein the original ultrasonic  
2 frequency signal has a frequency of 2 MHz or less.

1                   17.     The ultrasonic monitor of claim 15 wherein the first and second  
2 piezoelectric crystal are positioned in an wristwatch proximate to a radial artery of the  
3 subject.

1                   18.     The ultrasonic monitor of claim 15 wherein the first and second  
2 piezoelectric crystal are positioned proximate to an ulnar artery of the subject.

1                   19.     The ultrasonic monitor of claim 16 wherein the first and second  
2 piezoelectric crystals are inclined at a roof angle relative to each other of between about 0 and  
3 60°.

1                   20.     The ultrasonic monitor of claim 16 wherein the first and second  
2 piezoelectric crystals are inclined at a roof angle relative to each other of between about 5 and  
3 45°.

1                   21.     The ultrasonic monitor of claim 15 wherein the first and second  
2 piezoelectric crystals are positioned within a module and separated by a distance of between  
3 about 0.5 and 20 mm.

1                   22.     The ultrasonic monitor of claim 21 wherein the first and second  
2 piezoelectric crystals are separated by a distance of between about 1.0 and 10 mm.

1                   23.     The ultrasonic monitor of claim 1 wherein the ultrasonic energy source  
2 and detector are positioned within a module that is inclined relative to the subject.

1                   24.     The ultrasonic monitor of claim 23 wherein the inclination of the  
2 module results from an angular shape of the gel pad.

1                   25.     The ultrasonic monitor of claim 24 wherein a cross-sectional shape of  
2 the gel pad is one of triangular and trapezoidal.

1                   26.     The ultrasonic monitor of claim 1 wherein the associated hardware  
2 comprises a demodulator configured to convert a Doppler shift of the reflected ultrasound  
3 energy into a voltage.

1                   27.     The ultrasonic monitor of claim 26 wherein the demodulator comprises  
2     an FM demodulator.

1                   28.     The ultrasonic monitor of claim 26 wherein the demodulator comprises  
2     an AM demodulator.

1                   29.     A method for detecting pulse rates in living subjects, which method  
2     comprises:

3                         providing an ultrasonic monitor comprising,  
4                         a) at least one source of ultrasonic energy,  
5                         b) a gel pad comprised of a polymer and from about 50 to about 95 % by  
6     weight of an ultrasound conductive diluent, wherein said polymer is characterized by having,  
7                         i) needle penetration from about 5 to about 300 (1/10 mm) according to  
8     ASTM D15,

9                         ii) tensile strength from about 5 to about 500 psi according to ASTM

10    D412, and

11                         iii) elongation from about 50% to about 800% according to ASTM

12    D412,

13                         wherein said gel pad is positioned directly between the energy source and the  
14     living subject,

15                         c) an ultrasonic energy detector, and

16                         d) associated hardware and software for detecting, calculating and displaying a  
17     readout of the measured rate values; and

18                         contacting said monitor with the subject at the point where the pulse is to be  
19     measured.

1                   30.     A method of claim 29 in which the living subject is a human.

1                   31.     A method of claim 29 in which the monitor contacts the subject on the  
2     radial or ulnar artery.

1                   32.     A method of claim 29 wherein said pulse rates are selected from the  
2     group consisting of heart rate values, blood flow rate values, fetal heart rate values, and fetal  
3     blood flow rate values.

1                   33.     The method of claim 29 further comprising providing the ultrasound  
2 energy source and detector in a module, separated by a distance of between about 0.5 and 20  
3 mm and inclined relative to one another at a roof angle of between about 0 and 60°.

1                   34.     The method of claim 29 further comprising inclining the module  
2 relative to the subject.

1                   35.     The method of claim 34 wherein the module is inclined by resting on  
2 an angular shape of the gel pad.

1                   36.     An ultrasonic monitor for measuring pulse rate values in a living  
2 subject, comprising:

3                   a) at least one source of ultrasonic energy located in a module, the source  
4 emitting ultrasonic energy of an operating frequency of 2 MHz or less;

5                   b) an ultrasonic energy detector positioned in the module at a roof angle  
6 relative to the source; and

7                   c) associated hardware and software for detecting, calculating and displaying a  
8 readout of the measured rate values.

1                   37.     The ultrasonic monitor of claim 36 wherein:  
2                   said source of ultrasonic energy comprises a first piezoelectric crystal;  
3                   said detector comprises a second piezoelectric crystal; and  
4                   the roof angle is determined based on the distance of said energy source to the  
5 living subject.

1                   38.     The ultrasonic monitor of claim 37 wherein said first piezoelectric  
2 crystal is energized by an original ultrasound frequency signal, wherein the original  
3 ultrasound frequency signal is reflected off the living subject and received by the second  
4 piezoelectric crystal, and wherein said received ultrasound frequency signal is higher or  
5 lower than said original ultrasound frequency signal depending on direction and speed of  
6 fluid flow.

1                   39.     The ultrasonic monitor of claim 37 wherein the first and second  
2 piezoelectric crystal are positioned in an wristwatch proximate one of a radial artery and an  
3 ulnar artery of the subject.

1                  40.        The ultrasonic monitor of claim 37 wherein the first and second  
2 piezoelectric crystals are inclined at a roof angle relative to each other of between about 0 and  
3 60°.

1                  41.        The ultrasonic monitor of claim 40 wherein the first and second  
2 piezoelectric crystals are inclined at a roof angle relative to each other of between about 5 and  
3 45°.

1                  42.        The ultrasonic monitor of claim 37 wherein the first and second  
2 piezoelectric crystals are positioned within a module and separated by a distance of between  
3 about 0.5 and 20 mm.

1                  43.        The ultrasonic monitor of claim 42 wherein the first and second  
2 piezoelectric crystals are separated by a distance of between about 1.0 and 10 mm.

1                  44.        A method for detecting pulse rates in living subjects, which method  
2 comprises:  
3                  providing an ultrasonic monitor comprising,  
4                  a) at least one source of ultrasonic energy having an operating frequency of 2  
5 MHz or less,  
6                  b) an ultrasonic energy detector, and  
7                  c) associated hardware and software for detecting, calculating and displaying a  
8 readout of the measured rate values; and  
9                  contacting said monitor with the subject at the point where the pulse is to be  
10 measured.

1                  45.        A method of claim 44 in which the living subject is a human.

1                  46.        A method of claim 44 in which the monitor contacts the subject on the  
2 radial or ulnar artery.

1                  47.        A method of claim 44 wherein said pulse rates are selected from the  
2 group consisting of heart rate values, blood flow rate values, fetal heart rate values, and fetal  
3 blood flow rate values.

1                   48.     The method of claim 44 further comprising providing the ultrasound  
2     energy source and detector in a module, separated by a distance of between about 0.5 and 20  
3     mm and inclined relative to one another at a roof angle of between about 0 and 60°.